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~~INTERNATIONAL~~

LINCOLN HIGHWAY: WENDOVER CUTOFF, 1923-25

CROSSING GREAT SALT LAKE DESERT FOR 40 mi. BETWEEN KNOLLS AND WENDOVER
TOOELE COUNTY

UTAH

HAER
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PHOTOGRAPHS AND
WRITTEN AND HISTORICAL DATA

HISTORIC AMERICAN ENGINEERING RECORD
HERITAGE CONSERVATION AND RECREATION SERVICE
DEPARTMENT OF INTERIOR
WASHINGTON, DC 20243

HAER
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Historic American Engineering Record

Lincoln Highway Wendover Cutoff

HAER- UT-23

Location: Federal Highway between Salt Lake City and Wendover, Utah.

Date: 1932-1925

Original
Owner: State of Utah

Present
Owner: State of Utah

Condition: Replaced by Interstate Eighty

Significance: Last major link in the first transcontinental highway.
Solved problems presented by vast mud and salt flats.

Historian: T. Allan Comp, PhD, 1972

The Lincoln Highway Wendover Cut-Off

United States Highway Forty

The Wendover Cut-Off on the Lincoln Highway was one of the last links completed on the transcontinental, New York to San Francisco U.S. Highway 40. Constructed as Federal Aid Project 51-A and 51-B between 1923 and 1925 at a cost of \$380,000, the cut-off crossed the mud and salt flats of the ancient Lake Bonneville and required the assistance of both a railroad and a salt company before completion became a reality. An example of highway engineering and its capacity to combine with related experience whenever expedient, the Wendover Cut-Off serves to remind the historian of the American willingness to exploit technology and expertise whenever it may occur. A piece of difficult and largely unprecedented road construction, one may concur with the Engineering News-Record (April 23, 1925): "Altogether no more unique operation of road building than the Wendover Cut-Off in Utah has been recorded."

The old road left much to be desired. A narrow strip of gravel varying between seven and fifteen feet in width, the path was infamous for dangers. Cars would sink in the fine mud; salt water would ruin automobile parts; and the road was frequently washed out by wind-driven water.

No road had ever been constructed across the salt flats: They were quite safe when dry, but impassible during winter when they were inundated.*

Debate over the actual path the road was to follow was long and, at times, acrimonious. According to reports, the state of Utah and "a trail organization" differed over the choice of route and the resulting twelve year debate received nation-wide publicity. Finally, the U.S. Secretary of Agriculture stepped in to adjudicate, thus making the Wendover Cut-Off the only piece of road in 170,000 miles of the federal highway system on which the Secretary of Agriculture held a hearing before making a final decision. Seventy percent of the total cost of the road was paid for by the federal government; the remainder was divided equally between Utah and California.

The route selected ran 41.4 miles west from Knolls in Tooele County, Utah, to Wendover on the Utah-Nevada border. Virtually a straight line involving zero grades, the road would seem easy enough to construct. The difficulty was that the road had to cross a puddle of fine clay mud 500 to 600 feet deep covering 3,000 square miles. These mud flats were the remnant of the Pleistocene Age Lake Bonneville which once covered 20,000 sq. miles of Utah and Nevada. The monotony of the mud flat surface -- forty miles wide

* As early as 1912 race driver Teddy Tetzleff drove a Blitzen Benz across the dry salt flats at 144 miles an hour. The completed highway provided ramps at each end of the salt flats so motorists could leave the road and try their own luck.

where the highway crossed it -- was broken by an island or raft of salt deposited in the lowest portion of the old lake. During the summer the water table for both salt and mud flats was just under the surface, but in winter as much as fourteen inches of briny water would cover the area. This sheet of water would shift with the wind and at times these winds would create a rather fierce wave action that could quickly erode a clay embankment.

The Engineering News-Record (op.cit.) noted that "rarely nowadays does road construction offer anything new and particularly distinctive," and then went on to describe the construction problems and solutions of the Wendover Cut-Off as "a remarkable piece of construction." The challenge of building this "path across a mud puddle" eventually required the services of federal and state engineers as well as the Western Pacific Railroad and the Utah-Salduro Salt Company. The three contractors for the project all possessed the varied local and national experience and training necessary to overcome the largely unprecedented situation. N. E. Lamus, a native of Minnesota, had worked for a mining company in California for several years before becoming Master Mechanic for the Utah-Salduro Salt Company in its salt and potash works at Salduro. R. G. Zimmer had been General Superintendent of the Utah-Salduro Company since 1917. Born in Montana and a graduate of the Houghton, Michigan School of Mines, Zimmer had several earlier years of experience with mining companies in Nevada and Montana.

The office of General Superintendent for the entire Wendover project was occupied by Ora Bundy, a Purdue graduate in engineering and Major of Engineers during World War I. Bundy brought to the Utah project ten years of experience in construction and bridge engineering in the midwestern and southern states. H. C. Means, Chief Engineer for the Utah State Road Commission, directed the pre-construction studies of route and methods and Lee Wendleboe served as State Resident Engineer.

The problem of building a road across a mud and salt flat where no road had ever been built was indeed a "new one" as the State Chief Engineer commented. An embankment three feet high and twenty-four feet wide had to be created and although the highway paralleled the Western Pacific Railroad, it was not feasible to haul fill material in dump cars as the railroad had done when constructing its track. To haul in the 404,000 cubic yards of material needed for the project would have been so costly that construction would have been impossible. Instead, construction engineers decided the road would be built from "borrow," fill material taken from the actual construction site. A physical report on the soils found along the route showed that over 80% had more than 50% clay and were made of extremely fine particles (200 mesh). The bearing value of the soils was quite high, more than sufficient to support highway traffic, but the roadbed required protection from water and wave action.

Two additional factors made the decision to build the road feasible. The Western Pacific Railroad tracks demonstrated the stability of a fill on the mud and salt flats and the company offered to haul the 75,000 cubic yards of gravel necessary for road surfacing at a very low rate. Since the highway ran parallel to the railroad and just north of the railroad right-of-way (center lines of the railroad and highway were 117 feet apart), the railroad was able to dump the gravel at the edge of its tracks where highway construction crews could easily move it into place.

The salt and potash works at Salduro were the second and crucial contributor to the design and construction of the highway. Built and operated by the Utah Salduro Company, a branch of the Solvay Process Company, the works had been constructed as one of the war industries to perfect a method of reclaiming potash by solar evaporation. Several millions of dollars spent in experimental work enabled the company to accumulate machines and information adapted to the salt flats. In the process of building the huge vats required for its work, the company constructed some 700 miles of dikes in the salt beds. It was this experience that provided the literal key to road construction on the salt beds.

Material for the dykes, which formed the sides of the vats, was obtained from the clay underlying the salt crust. The fact was brought out that a bond could not be made sufficiently tight between the salt surface and the clay dyke to keep the fresh water, which accumulated in the salt beds every winter from working through. This developed the necessity of first excavating the salt along the edge of the

dyke down to the underlying clay, then building the dykes entirely of clay taken from a paralleling trench. In this manner the fresh water was kept from dissolving the salt from under the dykes and causing them to settle.

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It was in the building of these dykes forming the sides of the vats that the experience was gained which proved invaluable in the road construction. The same system modified to meet the existing condition was used in building the roadway across the salt beds. Adaptation from it solved the more serious difficulties of construction in the mud flats proper.*

With the difficulties of construction methods largely solved, work began on October 1, 1923. Three design factors had to be considered: the road had to be above any probable water accumulation; it had to provide for water flow as the wind shifted; and it had to be protected from wave action. An embankment made of "foreign" fill brought in from elsewhere was too costly, so the road base was built of clay "borrowed" on the construction site. Large trenching machines owned by the Utah-Salduro Company and used by them in dike construction were used to dig the fill for the embankment. Top width was set at twenty-four feet and the height at three feet. To enable the sheet of water that covered the flats in winter to shift with the wind, the road had eighty-one wooden culverts and six woodpile bridges. These were fastened with wood pins since the briny water made short work of any metal parts. The south slope of the fill was protected from wave action by the railroad tracks but the north slope was open to the wind-driven waves. To

* H. C. Means in Utah Highways Magazine, December 1924.

reduce erosion on this side it was graded to a more gradual one in six slope and then covered with gravel.

The salt bed section presented added difficulty. The fill for the road could only be stabilized if the small amounts of fresh water from rain could be prevented from washing away the salt. To do so, a key trench was cut under the road bed and backfilled with clay from a second trench. This solid core of clay prevented fresh water from washing through the salt under the roadbed, thus maintaining the stability of the fill. The trenching machine continued to make cuts through the salt and then to pull up the clay from underneath. This clay was then carried on a belt conveyor to the road fill. The machine used in the salt section was a Number Ten Buckeye trench excavator weighing about fifty tons and cutting a trench three feet wide and twelve feet deep. Due to the weight of the machine, trenches could not be spaced closer than ten feet. In some places as many as six cuts were required to build the roadbed and the belt conveyor was extended to seventy-two feet.

The "borrow" or clay used to build the road embankment was a very fine-grained material (200 mesh) that held a considerable amount of moisture. When exposed to the sun even for several weeks, only the top quarter of an inch of the material would dry, leaving the rest a wet mass impossible for graders or tractors to work on. It was soon discovered that wind was the most effective drying agent and that it was necessary to aerate the fill con-

stantly with plows, graders, and drags before it was in satisfactory condition for surfacing. This aeration was no easy task. On a two-mile section just east of Salduro, the two tractors assigned to this job travelled a total of 366 miles before the section was ready for gravel surfacing.

The final road surface was made of gravel hauled from the railroad gravel pit twelve miles west of Wendover. The road was eighteen feet wide and the gravel was crowned to an 8 inch depth in the center. Water pumped from the borrow trenches was used to compact the gravel before the road was finally opened to traffic in 1925.

Equipment used on the project was quite varied and deserves mention.

The trencher No. 10 used on the salt section performed remarkable work when running, but many difficulties required heavy repairs which necessitated closing down for long periods of time. This machine made a 3,800-ft. salt cut in one 24-hr. period and a 2,700-ft. clay cut in another 24-hr. period. As stated, a No. 9 trencher, remodeled to fit conditions, was used on the mud section. Still another trencher of the ladder type was used on the section in the vicinity of Arinosa. This was a P.&H. machine making a 42-in. cut 12 ft. in depth, but with the added difficulty of requiring the brine to be pumped from the trenches back of the machine. A No. D-5 Austin dragline machine and a P. & H. No. 206 dragline with 38-ft. boom were used in an especially soft part of the flat. A P. & H. crane machine with a clamshell bucket filled out the embankment where the trenchers had not delivered sufficient material. A 75-hp. Holt caterpillar attached to a Russell grader leveled the embankment in addition to moving other heavy machinery around as required. Another tractor was remodeled and used in connection with a steam piledriver in building the bridges. Three other tractors were used in connection with graders and levelers. A loader was used for the loading of the gravel along the rail-

road grade into Ford trucks which were equipped with 1½-yd. dump bodies. Wheelers and fresnos were also used in moving gravel from the railroad to the highway.*

When the road was completed, a victory arch was erected near Salduro and the governors of Utah and Nevada, aided by U. S. Secretary of Agriculture William M. Jardine, officially opened the road to traffic on June 15, 1925. The victory arch was well-deserved. The project involved many men and well over \$100,000 in equipment, all working on a twenty-four schedule for sixteen months. Unprecedented design and construction problems had been overcome; difficult and often painful working conditions were endured; and still costs totaled only \$9,164 per mile. By combining the experience of the railroad and the salt works with the expertise of highway engineers and adding a small dose of determination, the Wendover Cut-Off on the Lincoln Highway had become a reality.

T. Allan Comp.
Project Historian
August 1972

* Engineering News-Record, April 23, 1925.

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The Wendover Cut-Off attracted considerable attention while it was under construction. The most thorough coverage may be found in the series of articles published in the Utah Highways Magazine. There was also a documentary film prepared by the U.S. Department of Agriculture Extension Service.

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Each a brief comment on work progress and developments. Several articles by supervisory personnel.

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